THURSDAY, FEBRUARY 17, 1876

THE LISBON MAGNETIC OBSERVATIONS

Annaes do Observatorio do Infanto D. Luiz. Magnetismo Terrestre. Lisbon Imprensa Nacional. (1870, 1874.)

THAT in 1858 Portugal entered into "the Magnetic Union of Nations, founded by Gauss and by Humboldt in 1832," was due to the enlightened solicitude of the King Luiz I. for the progress of science. The observatory founded by him at Lisbon, and placed under the care of the late Mr. de Silviera, has during the last years been directed by Mr. de Brito Capello, who had previously the oversight of the magnetic department, and to whom we believe the results in the two parts of Annals before us are chiefly due.

The value of the Lisbon observations and of these results is so much the greater that the neighbouring country, Spain, has done nothing for terrestrial magnetism, and even France, which stands so high in science, has given us no such series of observations since Arago originated them by the devotion of years to the movement of the magnetic needle.

The first part of the Annals before us (1870) treats of the results for the magnetic declination derived from direct observations made at 8 A.M. and 2 P.M. (1858-1868), and for the diurnal variations (1864-1868) from a photographic registering apparatus similar to that at Kew. The secular variation is first investigated. This mysterious movement, which we can attribute to no known cause, as it has no known period, is shown at Lisbon by a mean approach of the north end of the needle to the north at the rate of 5′·9 a year during ten years, but varying from a minimum of 4′·8 in 1858-9, to 8′·2 in 1866-7. An annual law has also been found consisting of an oscillation of 1′·5, the needle being nearest the north in June, and farthest from it in December and January.

The diurnal variation at Lisbon resembles to a considerable extent that obtained at more northern stations in Europe. The periodic variation of the mean range of this oscillation, first discovered by Dr. Lamont, which occupies from ten to twelve years, has also been found at Lisbon. This investigation has its importance increased by the fact that the greatest and least mean oscillations happen at the same times as the maximum and minimum frequency of solar spots. The coincidence first indicated by Sir E. Sabine, with reference to magnetic disturbances, was remarked independently by Dr. Rudolph Wolf, of Zurich, who has made it the subject of an extensive and valuable series of investigations. Dr. Lamont, commencing with Cassini's observations, has found the mean duration of the magnetic period to be 10·43 years, while Dr. Wolf obtains 11·11 years from a longer, though perhaps less certain, series of solar spot observations. Since there can be no doubt that the yearly variation of sunspots and of the amplitude of the diurnal oscillation of the magnetic needle follow the same law and depend on the same cause, every new determination of the epochs of maxima and minima is of value, fixing points which will determine the mean duration and variable length of the period, and thus probably lead us to a knowledge of the common cause. The Lisbon observations give 1859·9 and 1867·0 as epochs of maximum and minimum, agreeing very nearly with those derived from the Munich and Trevandrum observations. In the determination of the mean duration, everything depends on where we commence. If we begin with Arago's magnetic observations, the mean duration is about 10·7 years; if we take the most accurate results for the sunspot area from Messrs. De la Rue, Stewart, and Lœwy, we find 11·2 years, nearly that deduced by Dr. Wolf. Evidently a much longer series of accurate observations is required to determine the length of a period which has varied between 8 and 12·3 years within the last half century; though we believe Dr. Lamont's result to be nearly true.

As the Observatory establishment was not sufficient for the long calculations required for the investigations connected with the lunar diurnal variation, the latter was sought approximately from the effects of the lunar action in diminishing or increasing the solar diurnal oscillation at different days of the moon's age. It was thus found that the diurnal oscillation from 8 A.M. to 2 P.M. was greatest when the moon was three and eighteen days old, while it was least when she was ten and twenty-four days old. This indicates a semi-diurnal oscillation due to the moon's action, with an amplitude of 1′ nearly, having the maximum westerly positions when the moon is near the upper and lower meridians.

It is remarked by Mr. Capello, with reference to disturbances, that in many cases the observations taken as disturbed (those differing from the normal position by 2′·26 or more) were, properly speaking, not disturbed observations, but belonged to very regular curves, in which the morning minimum was more marked or the afternoon maximum was less so than usual. Whereas disturbances are shown by serrated curves. This remark is quite exact, and the fact becomes even more marked in lower latitudes. The investigation for the lunar variation just noticed will show one cause for this variation of the amplitude of the diurnal oscillation which is greater the greater the lunar action.

The second part of the Annals before us (1874) contains the discussions for the other magnetic elements. Mr. Capello finds, from nine years' observations, that the horizontal force of the earth's magnetism was greatest in July, least in September, with a secondary maximum in November, and minimum in February. This result depends on few observations, but approaches considerably to that obtained first at Makerstoun. The very marked minimum found for the month of September induced Mr. Capello to examine whether this might not be due to the action of disturbances, which in general diminish the earth's magnetic force; it results from this discussion that though the disturbances have a considerable effect in increasing the amplitude of the annual oscillation, yet the maximum in December is best marked in years of least disturbance. This result he confirms by an examination of the Kew observations, and it agrees with that deduced from each of a series of years' observations of the bifilar at Makerstoun. Mr. Capello also finds that the Munich observations show the most marked minimum in September and October, in years of least disturbance. It is an important fact, confirmed by the results from many observatories, that the horizontal force of the

earth's magnetism is a maximum near the solstices, and a minimum near the equinoxes.

The diurnal variations of horizontal force, deduced from the photographic registration of the bifilar magnetometer, follow laws similar to those at Munich, and not differing greatly from those at Makerstoun, 17° further north; the minimum, however, shifting from near 9 A.M. in summer to about 2 P.M. in winter.

The balance magnetometer seems to be the least certain of the variation instruments at Lisbon. The temperature coefficient (obtained by heating the air with gas jets) has been found with an opposite sign to that due to variations of the needle's magnetism, a result which is always unsatisfactory even when the variations of temperature are small as they are at Lisbon. The diurnal variation of the vertical magnetic force differs considerably from that obtained at more northern observatories, the minimum occurring in each month of the year near noon, and the maximum near 5 P.M.

Mr. Capello has evidently bestowed much pains on the determination of his instrumental constants, and this publication of results contains a valuable contribution to our knowledge of the magnetic laws for an important station, near the most southerly and westerly point in Europe. Lisbon, like nearly every other magnetic observatory, has been obliged to be satisfied with single instruments of each kind. When so many observatories were founded between thirty and forty years ago, there was perhaps an over confidence in the excellence of the instruments employed, and in the certitude of being able to correct the observations to be obtained from them for every possible error. There was also the economical consideration connected with the expense of a double series of instruments, as well as the additional labour incurred in observing two instruments for the same purpose. The consequence has been, to take a single illustration, that no two observatories have given exactly the same law for the annual variation of the mean position of the magnetic needle. One observatory has contradicted another, the results from a good instrument have been balanced by those from a bad one, and in other cases it has not been possible to determine whether the differences found at two stations were really due to difference of locality only, or to instrumental causes.

When we remember the vast labour (to omit every other consideration) expended in obtaining the laws of magnetic variations, it cannot be too much regretted that every observatory was not furnished with a double series of instruments, which would have shown by their agreement or disagreement the accuracy or error of the results obtained from them. In the case of disagreement the director of the observatory would have been warned that some error existed whose cause should be sought out. No preliminary trials can ensure that an instrument will remain with exactly the same errors. If we could suppose that the captain of a ship would set sail on a lengthy and costly voyage with a single chronometer, without any means of verifying the accuracy of its going except the meeting with another ship in a like predicament, and should then find that, according to their chronometers, they were on opposite sides of the globe, we should have a parallel to a not uncommon case in the work of many magnetic observatories.

It is to be hoped for the future that such differences will not be allowed to exist, that each observatory will have the means of proving that, for its locality at least, the laws obtained are true, and that in publishing the observations, the differences of the indications of two instruments of each kind will be given with the most complete exposure of their errors and corrections.

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MARSDEN'S "NUMISMATA ORIENTALIA"

Marsden's International Numismata Orientalia. Part II. Coins of the Ursuki Turkomans. By Stanley Lane Poole, Corpus Christi College, Oxford. (London: Trübner and Co., 1876.)

THIS is the second part of the series of separate publications on the Early Coins of the East, of which the first part on Ancient Indian Weights was reviewed in NATURE, vol. xii. p. 24. The whole work is intended to be a new edition of Marsden's "Numismata Orientalia," but in consequence of the new form of the work and its enlarged character, the editor has changed its title into that of the "International Numismata Orientalia."

Part II. has been undertaken by Mr. Stanley Lane Poole, and treats of the Coins of the Ursuki dynasty. Ursuk was one of the petty chiefs of Syria during the wars of the Crusades, in which he distinguished himself, and was made Governor of Jerusalem, A.D. 1086. His descendants, the Ursuki princes, were amongst the most powerful chiefs in Syria and Mesopotamia, until the dynasty was brought to a close by the Tartar invaders, A.D. 1242. An historical sketch of the Ursuki family is given by Mr. Poole as an introduction to the account of their coins.

The series of Ursuki coins described in the work, the greater part of which are now in the British Museum, are mostly copper coins, a few only being of silver. Several plates with clear lithographic and photographic representations of the coins form part of the work. The coins all bear Arabic inscriptions, some of considerable length, and they appear to be of much historical value. In the description of the several coins in the text of the work the old Arabic inscriptions on each coin are given in the more modern Arabic character, according to the system of transliteration adopted in the book. These inscriptions are, however, intelligible only to Arabic scholars, as no English translation is given, which would have added considerably to the interest of the work for general readers.

At the commencement of the Ursuki dynasty the Mahometan moneys were of three classes—gold, silver, and copper, the respective units being the *dinar*, *dirhem*, and *fels*. But the Ursuki coins, both copper and silver, appear to be *dirhems*, this word appearing in the inscription of many of the coins, and showing that they were intended to pass as *dirhems*. Some of the copper coins have a thin coating of silver, and one has been gilded.

The Ursuki princes were amongst the few Mahometan dynasties that introduced images on their coins. But they rarely, if ever, engraved their own heads or those of their suzerains on their coins, choosing instead the types of the gold coins either of the Byzantine Emperors or of the Greek Kings of Syria.